

# CONTROLLING POWER AND ACCESS OF WIRELESS DEVICE TO BASE STATIONS WHICH USE CODE DIVISION MULTIPLE ACCESS

This is a divisional of application Ser. No. 08/234,757 filed Apr. 28, 1994, now U.S. Pat. No. 5,671,218.

## FIELD OF THE INVENTION

This invention relates to the field of wireless communications. More particularly it relates to more efficient use of a designated frequency spectrum by code division multiple access (CDMA) techniques and access protocols.

## BACKGROUND OF THE INVENTION

The recent growth in the use of wireless communication devices, such as mobile telephones, wireless local area networks (LANs) and wireless private branch exchanges (PBXs) has strained the capacity of the electromagnetic frequency spectrum these devices use. Various techniques have been proposed and used for determining which wireless devices are given access to the available frequency spectrum and for efficiently using the available frequency spectrum.

In order to communicate, a wireless device must typically first gain access to an uplink frequency channel of a base station. Base stations typically give access to one wireless device on a single uplink frequency channel based on known protocols such as ALOHA and Busy-Tone. In both of these protocols, a wireless device transmits a request signal to a base station on a request frequency channel and if there are no other wireless devices transmitting request signals at that moment, access to an uplink frequency channel is granted. These protocols while adequate for servicing voice communications on circuit switched networks are not adequate to service sources which transmit bursts of information on packet switched networks.

In addition to protocols which determine which single wireless device is allowed access to a single uplink frequency channel, techniques for permitting the simultaneous access by multiple wireless devices to a single uplink frequency channel of a base station are known. One of these techniques is code division multiple access (CDMA). In CDMA, a digital signal located at a wireless device is multiplied at the wireless device by a unique code corresponding to that device, which spreads the digital signal over a greater bandwidth. For example a 10 kHz. digital signal may be multiplied by a code which effectively creates a 100 kHz spread digital signal.

The spread digital signal is used to modulate a carrier frequency signal which is in the range of the uplink frequency channel and the modulated carrier is transmitted from the wireless device to the base station. The base station receives a composite spread signal of all the modulated carrier frequency signals from all wireless devices transmitting at that point in time. The base station demodulates the composite spread signal and then partially despreads the demodulated signal using the same unique code used at a particular wireless device for spreading. The partially despread signal approximates the prespreading data signal for the particular wireless device.

Despreading causes the signal from a particular wireless device to have a power advantage over signals from other wireless devices simultaneously transmitting and thus allows the signal from that particular wireless device to be separated from the signals from the other wireless devices.

The power advantage for a particular wireless device is proportional to the spreading bandwidth divided by the data rate for that wireless device. Thus spreading undesirably causes wireless devices with lower data rates to have greater power advantages and consequently greater quality of service than wireless devices with higher data rates.

A new approach for CDMA access by a plurality of wireless devices is needed for wireless devices which have differing data rates and differing quality of service requirements.

## SUMMARY OF THE INVENTION

The present invention in one embodiment provides a method and apparatus for controlling the power transmitted by a wireless device based on the type of wireless device. Preferably, the type is defined by the data rate and quality of service requirements for the wireless device. The power transmitted by a particular wireless device is controlled so that the ratio of the power received at a base station receiving antenna from the particular wireless device to a minimum power level is proportional to the ratio of the data rate of that device to a minimum data rate. In addition, the power transmitted by the particular wireless device is controlled such that the ratio of the power received from the particular wireless device to a minimum power level is proportional to the ratio of the quality of service requirement of that device to a minimum quality of service requirement. The base station of the present invention preferably employs CDMA technology through the use of a despreader.

The present invention in another embodiment provides a method and apparatus for determining whether a particular wireless device is given access to an uplink frequency channel based on an equivalent population value and an equivalent current load value. Wireless devices with higher power levels as required by higher data rates or higher quality of service requirements are given proportionately higher current load shares and population shares for determining an equivalent population value and an equivalent current load value respectively.

The equivalent current load and equivalent population values are preferably used by a base station to determine probability of transmission values for wireless devices of particular types. The type of wireless device is preferably defined by the device's data rate and its quality of service requirement. The probability of transmission value is used by a random generator, preferably at the base station, to determine when a wireless device is permitted access to an uplink frequency channel. Alternatively, the base station may transmit equivalent current load and equivalent population values to wireless devices of a particular type and those wireless devices can then determine the probability of transmission value.

The present invention permits the statistical multiplexing of a large number of different types of wireless devices with different data rates and quality of service requirements. It also allows peak capacity access by one wireless device when all other wireless devices are idle. Furthermore, the present invention allows for the setting of priorities for fair capacity sharing among all busy wireless devices and makes efficient use of the available frequency spectrum.

The above discussed features, as well as additional features and advantages of the present invention will become more readily apparent by reference to the following detailed description and the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a base station and two wireless devices;